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HYDROGEN PEROXIDE AND THIOUREA TREATMENT OF BITTERBRUSH SEED

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ABSTRACT

Bitterbrush seeds receiving a thiourea treatment or an array of hydrogen peroxide treatments were compared as to emergence rate and total emergence. Total emergence from some hydrogen peroxide treatments equaled emergence from the thiourea treatment. Peak emergence of thiourea-treated seed was greater in magnitude and 2 weeks earlier than the emergence peak of seed treated with hydrogen peroxide. Emergence patterns suggest that field use of hydrogen peroxide-treated seed may increase seedling survival through avoidance of frostkill.

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Thiourea has been the standard treatment for breaking seed dormancy in antelope bitterbrush (*Purshia tridentata* DC.) (Pearson 1957; USDA Forest Service 1974). Bitterbrush dormancy has also been overcome by stratification (Hormay 1943); by scarification by sandpaper or hot water, and stratification (Peterson 1953); by gibberellic acid and stratification (McConnell 1960); or by washing, scrubbing, and stratification (Carlson 1974). The thiourea treatment is preferred because it is simpler than the other treatments, and because it results in dry seeds that are easier to plant than moist, stratified seed. However, workers exposed to thiourea can suffer toxic effects (Sax 1968). Also, although thiourea is effective in overcoming physiological dormancy, field plantings of thiourea-treated seed are often unsuccessful.

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In order to induce germination, Crocker (1916) suggested that hydrogen peroxide be used to increase the amount of oxygen available to embryos in dormant seeds. Pack (1921), Shearer and Tackle (1960), and Trappe (1961) used H_2O_2 to hasten and increase germination of forest tree seed. Riffle and Springfield (1968) increased germination of shrubs *Cowania mexicana* and *Cercocarpus montanus* by washing seeds with a 30 percent H_2O_2 solution. Stein (1965) field-planted conifer seed pretreated with 1 percent H_2O_2 solution and found emergence and survival increased in two of three tree species tested. In concentrations of 3 percent or less, H_2O_2 is not hazardous. The purpose of the study reported here was to test hydrogen peroxide as a safe and effective alternative to thiourea.

METHODS

Emergence of bitterbrush seed receiving a standard thiourea treatment was compared to that of seed standing or shaken in two concentrations of hydrogen peroxide. Seeds from California, Idaho, and Nevada were used to test the consistency of response among seed sources. Young seedlings were observed for abnormalities until they were outplanted.

Seeds treated with thiourea were soaked in a 3 percent solution for 20 minutes and then air-dried. A commercial grade 3 percent H_2O_2 solution was diluted to 1 and 0.5 percent for the seed treatments. Seeds were placed in a 1 percent solution and either allowed to stand for 3, 5, or 7 hours or mechanically shaken for 3 or 5 hours. Seeds in the 0.5 percent solution were subjected to the same treatments, with additional 16-hour stand treatment and 7-hour shake treatment. All H_2O_2-treated seeds were air-dried for 7 days except seeds in a duplicate 16-hour stand treatment that were planted wet. Untreated seeds from each seed source were also planted.

Each treatment was replicated twice for each seed source with 25 seeds per replicate. Seeds were planted in the greenhouse in January, in plastic flats (6 by 51 by 26 cm) filled with fine perlite. Depth of planting was 1 cm and spacing was 2 cm within rows and 2.5 cm between rows (treatments). Seed sources and all treatments were assigned at random to all flats subject to the constraint that no treatment was replicated for an accession within the same flat. Since location effect was judged to be extremely small, this departure from a completely randomized design was ignored in the statistical analysis.

Perlite flats were maintained near field capacity throughout the 12-week study period. Fungicide (Captan)[2] was applied equally to all flats as necessary.

Plant emergence was recorded every 7 days. A plant was considered to have emerged if its cotyledons were completely free from the surface of the perlite. Emergence results from each seed source were tested individually by analysis of variance for significant ($P<0.05$) differences between treatment means.

To prevent crowding within the flats, individual seedlings were removed and transplanted in separate containers as they emerged. Seedling appearance and root length were noted at this time.

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[2]Use of trade or firm names is for reader information only, and does not constitute endorsement by the U.S. Department of Agriculture of any commercial product or service.

RESULTS

Plant emergence was significantly different ($P<0.05$) among seed treatments within a seed source. Seed response to treatment was most often consistent among seed sources. Emergence in 37 of the 42 treatments tested was increased at least 10 percent over nontreated seed (table 1). Seedling emergence was greater from seeds treated with 1 percent H_2O_2 than 0.5 percent H_2O_2 for the 3-, 5-, and 7-hour soak treatment and for the 3- and 5-hour shake treatment. Mechanical shaking increased emergence over the standing treatment for the same time period in both 0.5 and 1 percent solutions.

Table 1.--*Total emergence of thiourea- and H_2O_2-treated seed. All treated seed were air-dried 7 days unless otherwise noted*

Treatment (hours)	Seed source		
	Nevada	California	Idaho
	Percent		
None	16	34	46
3% thiourea	74	90	72
0.5% H_2O_2			
Soak			
3	34	48	40
5	28	46	50
7	30	56	50
16	50	54	68
16 1/	48	64	62
Shake			
3	49	50	40
5	48	44	64
7	52	50	60
1% H_2O_2			
Soak			
3	38	38	58
5	66	72	76
7	62	70	76
Shake			
3	50	86	92
5	78	82	82

1/ Seed planted immediately without drying.

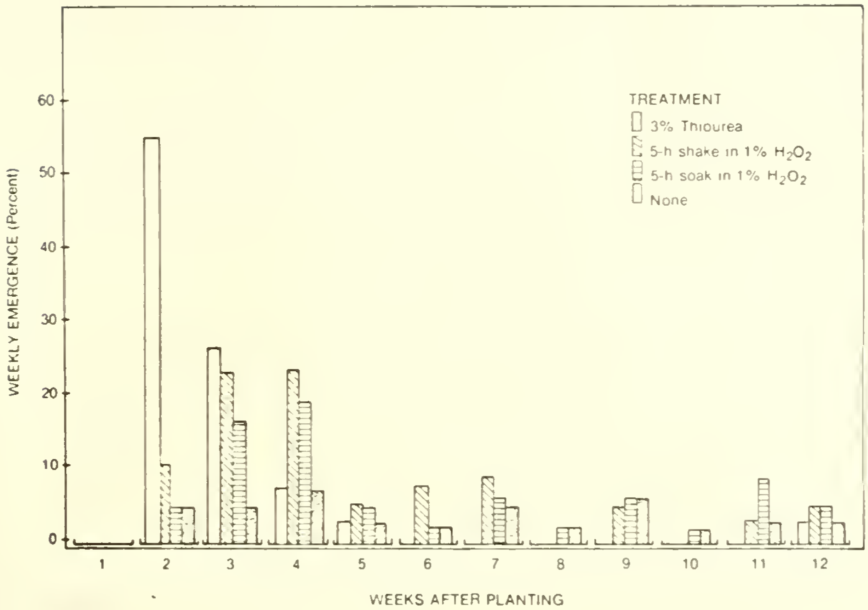

Figure 1.--Typical emergence pattern of antelope bitterbrush (Purshia tridentata *DC.*) *seedlings (California seed source).*

The magnitude and duration of emergence varied among treatments (fig. 1). Emergence of thiourea-treated seed was 90 percent completed by the second or third week. Emergence of H_2O_2-treated seed was more evenly distributed throughout the study period with a major peak in the third and fourth week. Peak emergence was always greater in thiourea-treated seed.

Seedling root length was similar at the time of emergence among treatments and there were no abnormalities noted in plant appearance. The seedlings continued to develop normally during the next 6 months before they were outplanted.

DISCUSSION

Throughout most of the range of antelope bitterbrush, and particularly in western Nevada, mild temperatures during early spring may be followed by hard frosts. This sequence kills seedlings (Ferguson and Monsen 1974) and the actively growing succulent tissues of mature plants (Smith and others 1965). Bitterbrush seedlings emerge during the mild period, and those in the cotyledon stage are easily killed by a subsequent cold snap. Plants that have developed to the first leaf stage are more resistant to frost and may not be severely affected.

The probability of complete seedling loss due to frostkill is less with H_2O_2-treated seed. The prolonged emergence pattern of H_2O_2-treated seed implies that only a portion of the seedlings are endangered by frostkill at any given time. The rapid emergence of thiourea-treated seed is excellent for dry sites, but a majority of the seedlings are subject to frost damage at the same time.

The choice of seed pretreatment for field planting should be based on the adaptation of the emergence pattern to the weather characteristics of the site. Where soil moisture is depleted rapidly and hard frost is not a problem, the thiourea treatment is more applicable. Where soil moisture gradually declines and hard frosts occur, the H_2O_2 treatment is more promising.

Field trials are underway to document emergence response to pretreatment under various soil and climatic conditions. Preliminary results indicate H_2O_2-treated seeds have greater emergence than thiourea-treated seeds when planted early but reduced emergence when planted in late spring. Further field evaluation is needed to define concisely those situations where H_2O_2 pretreatment is most effective.

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